PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : H01Q 1/08, 1/20, 1/32 — A1

(11) International Publication Number: WO 96/31917

(43) International Publication Date: 10 October 1996 (10.10.96)

(21) International Application Number: PCT/AU96/00185

(22) International Filing Date: 1 April 1996 (01.04.96)

(30) Priority Data:

PN 2179	6 April 1995 (06.04.95)	AU
PN 8194	21 February 1996 (21.02.96)	AU

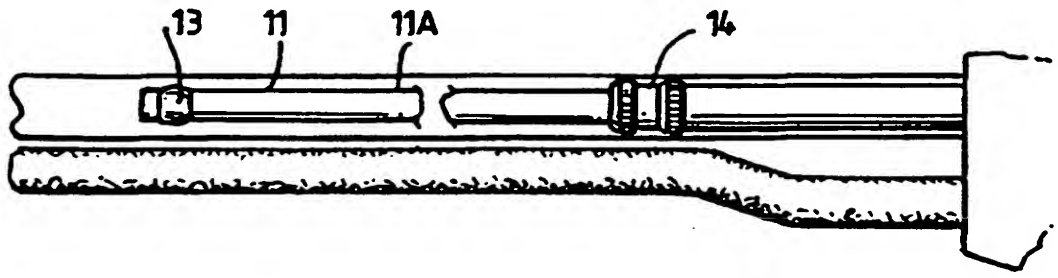
(71)(72) Applicant and Inventor: MATTHEWS, Robert, Lenes [AU/AU]; 22 Warner Court, Donvale, VIC 3111 (AU).

(74) Agent: MURRAY, James; James Murray & Co., Suite 12, 118 Church Street, Hawthorn, VIC 3122 (AU).

(81) Designated States: AL, AM, AT, AU, AZ, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(54) Title: ANTENNA



(57) Abstract

A rod antenna (11) which comprises a solid core (11A) selected from the group consisting of conductive and non-conductive cores overlaid by a filament-based element wrapped around the core at an angle to a line notionally drawn longitudinally along the core.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AM	Armenia	**GB**	United Kingdom	**MW**	Malawi
AT	Austria	**GE**	Georgia	**MX**	Mexico
AU	Australia	**GN**	Guinea	**NE**	Niger
BB	Barbados	**GR**	Greece	**NL**	Netherlands
BE	Belgium	**HU**	Hungary	**NO**	Norway
BF	Burkina Faso	**IE**	Ireland	**NZ**	New Zealand
BG	Bulgaria	**IT**	Italy	**PL**	Poland
BJ	Benin	**JP**	Japan	**PT**	Portugal
BR	Brazil	**KE**	Kenya	**RO**	Romania
BY	Belarus	**KG**	Kyrgystan	**RU**	Russian Federation
CA	Canada	**KP**	Democratic People's Republic of Korea	**SD**	Sudan
CF	Central African Republic			**SE**	Sweden
CG	Congo	**KR**	Republic of Korea	**SG**	Singapore
CH	Switzerland	**KZ**	Kazakhstan	**SI**	Slovenia
CI	Côte d'Ivoire	**LI**	Liechtenstein	**SK**	Slovakia
CM	Cameroon	**LK**	Sri Lanka	**SN**	Senegal
CN	China	**LR**	Liberia	**SZ**	Swaziland
CS	Czechoslovakia	**LT**	Lithuania	**TD**	Chad
CZ	Czech Republic	**LU**	Luxembourg	**TG**	Togo
DE	Germany	**LV**	Latvia	**TJ**	Tajikistan
DK	Denmark	**MC**	Monaco	**TT**	Trinidad and Tobago
EE	Estonia	**MD**	Republic of Moldova	**UA**	Ukraine
ES	Spain	**MG**	Madagascar	**UG**	Uganda
FI	Finland	**ML**	Mali	**US**	United States of America
FR	France	**MN**	Mongolia	**UZ**	Uzbekistan
GA	Gabon	**MR**	Mauritania	**VN**	Viet Nam

TITLE OF THE INVENTION: Antenna

FIELD OF THE INVENTION: This invention relates to a rod antenna, in particular to a continuous solid rod whip antenna and in particular to a rod of selected stiffness and flexibility which may be extended or retracted and stored in a relatively small space. It further relates to a tubular member useful for flexible storage of such a rod antenna.

BACKGROUND OF THE INVENTION: Telescopic and rod antennas are known. The telescopic types of antenna have the disadvantage that they are complex to make and tend to be fragile. Both telescopic and rod antennas can be extended either by hand or using a motor.

Some known rod antennas are roof-mounted and column-feed of the type designed to be manually retracted. There are also whip antennas of the type which are externally fixed to the window column or roof and or other areas of the vehicle which are not raised or lowered manually.

Many metal antennas of the column-feed type consist of two or more sections of a telescopic type antenna. There has been a continuing attempt to reduce noise levels within modern vehicles. It has been found that the step-down between each section of a telescopic antenna creates undesirable wind noise. One attempt to eliminate this wind noise has involved replacing roof-mounted, column-feed type telescopic antennas with solid metal rods, providing a smooth antenna surface.

Solid rod metal antennas have disadvantages in that they are of excessive weight, are lacking in flexibility and distort permanently when kinked or bent. This distortion

prevents manual raising or lowering. In addition, if the solid metal antenna catches on an external object, permanent damage to the vehicle may occur.

Both telescopic and rod antennas suffer from the difficulty that the telescopic section or the solid rod is likely to deform permanently upon collision forming an obstacle preventing the antenna from retracting.

It is one object of this invention to provide rod antennas which are tough as well as having a selected degree of flexibility.

It is a particular object of this invention to provide a whip or rod antenna of the type designed to be located at any suitable point of the vehicle and retracted or lowered either by motor or by hand.

It is a further object of this invention to provide a tubular member useful for flexible storage of a rod antenna.

BRIEF SUMMARY OF THE INVENTION: In one aspect, this invention provides a rod antenna which comprises a solid core selected from the group consisting of conductive and non-conductive cores overlaid by a filament-based element wrapped around the core at an angle to a line notionally drawn longitudinally along the core.

In another aspect, this invention provides a rod antenna which comprises a solid core selected from the group consisting of longitudinally arranged metallised non-metallic fibres and longitudinally arranged metal fibres.

In yet another aspect, this invention provides a rod of selected stiffness and flexibility which may be extended or retracted and stored in a relatively small space, wherein the

dimensions of the rod and the material or materials from which it is made are so selected that:

the bending radius as measured by the survivable bend has a bend diameter (D) to antenna diameter (d) ratio of from 80 to 120 together with inherent built-in memory to allow the rod to return to the original straight position when released.

In a further aspect, this invention provides a tubular member useful for flexible storage of a rod antenna, which comprises a relatively flexible cylindrical housing provided with at least two anchoring means for attachment of the housing to a vehicle body.

BRIEF DESCRIPTION OF THE DRAWINGS: One embodiment of the invention is illustrated in the accompanying drawings, in which:

- Figure 1 is a partial cross-section view of a roof-mounted, column-feed, manually retractable antenna; and

- Figures 1 (a), 1(b) and 1(c) are details of the antenna of Figure 1.

The accompanying drawings also illustrate an embodiment of the invention in which:

- Figures 2 and 3 are side views of a retracted antenna in a housing;

- Figure 4 is a side view of the retracted antenna of Figures 2 and 3 showing the position of a motorised erecting and retracting unit;

- Figure 5 repeats the side view of Figure 2 but shows the retracted antenna in a housing inside that structure of a car adjacent its boot:

- Figures 6(a) and 6(b) are side-views (perpendicular to each other) illustrating alternative motorised erecting and retracting units for use with the antenna of Figures 2 and 3; and

- Figure 7 illustrates a modification of the antenna of Figures 2 and 3, in particular a modified cylindrical housing.

DETAILED DESCRIPTION OF THE INVENTION: With regard to the first aspect, one example of filament-based element is braiding which involves interweaving groups of filaments. The groups of filaments are generally flat with filaments laid in parallel. Thus a first series of groups is interwoven with a second series of groups, one series being generally at right angles to the others. Interweaving involves generally laying one group over and under corresponding groups at right angles.

The braid may be laid around the core at a suitable angle selected from 5 degrees to 75 degrees to a line notionally drawn longitudinally along the core. The angle is preferably 40 degrees to 50 degrees.

As an alternative to braiding, filament winding may be used. Thus filaments are wound one over the other around the core but are not interlocked.

In another alternative, tapes or sheets of filaments may be wound around the core.

In yet another alternative, the tapes or sheets of conductive filaments may be woven.

In a further alternative a prewoven sock of filaments may be pulled over a core.

In yet a further alternative, a heat-shrink sleeving comprising a conductive plastics material may be placed around a non-conductive core and then shrunk to produce an electrically conductive rod.

The solid core is preferably a polymeric material which is associated with or impregnated with a strengthening material such as fibreglass or carbon fibres.

Generally speaking electrical conductivity is on the surface of the rod antenna. Surface conductivity may be provided using carbon fibres, metal or metallised fibres.

The metallised fibres may be, for example, nickel-plates, silver-plates or aluminium. The fibres themselves may be, for example, fibreglass.

Metal fibres may be, for example, stainless steel, copper, or aluminium.

The solid core is preferably formed by pultrusion, which is a process in which continuous strands of fibrous reinforcing materials are pulled through a resin bath, a heated die, a pulling station and finally a cut-off unit.

Carbon fibres, metallised fibres or metal fibres may be pultruded over a suitable core, or fibreglass, carbon fibres, Kevlar fibres or boron fibres, for example. Such fibres may be oriented in the longitudinal direction or may be braided to provide the desired modulus, strength and flexibility. The modulus of the fibres is selected according to their electrical conductivity and desired flexibility.

The resin matrix may comprise a polyester or polyesters, a vinyl ester or esters or thermoset resin blends.

Conductivity may be enhanced by the addition of conductive particles such as graphite flakes and/or powder, nickel or silver-plated carbon particles, for example, into the resin matrix.

Although the pultrusion method is preferred, it is possible to use for example, a method combining pultrusion with braiding. Other suitable means of producing rods for antennas include injection moulding and extrusion using chopped fibres and or particles of the type described above.

The word "rod" as used in this specification refers to elongated objects of various cross-sections including round, square and rectangular.

Preferably, the tensile strength of the rod at three standard deviations below the mean exceeds 1200 MPa when tested according to modified ASTM D - 3916.

Preferably, the tensile modulus at three standard deviations below the mean exceeds 50 GPa when tested according to ASTM D - 3916.

Preferably, the elongation at break is less than 3%.

Preferably, mounting shear splintering does not progress further than 30mm on a standard mounting shear splintering apparatus.

The rod should have inherent memory to return to its approximate straight position when fully extended.

It is necessary to balance flexure and stiffness of the rod to ensure that the rod can maintain its memory to return to its original shape and be inserted into a space or tunnel having a selected shape.

In particular aspects, the material or materials from which the rod is made may be metallic, non-metallic or a combination of both. For example, the metallic material may be entirely of metal or metal coated with chromium or may be of metallised fibres. The non-metallic material may be carbon fibre, carbon mesh or carbon powder. Non-conducting fibre, such as glass fibre, may be used to form a foundation or core for the rod. Pultrusion may be used in the construction of the non-metallic rod or metal fibres or metallised fibres. Conductive particles, such as metal particles, may be used to improve conductivity.

It has been found that rods according to the invention provide reduced wind noise.
The antenna housing and rod can be installed to any suitable location on a motor vehicle including windscreen pillars, roof, the front or rear fenders and/or boot.

Since the rods according to the invention may be retracted into a small space, the antenna length may be extended to provide further reception range.

The antenna according to the invention may be housed within a tube within a vehicle. This tube of selected stiffness may be left in a continuous straight length, bent into a selected shape or rolled up.

This invention also provides a rigid metal tube or pipe with an electrical insulated coating on the outer surface of the metal tube such as polyvinyl chloride, nylon, polypropylene or other suitable plastics material. The metal tube can be stainless steel, copper or a number of suitable electrically conductive metals capable of being pre-formed to a given shape.

The tube can be preformed or bent into any desirable shape to suit the motor vehicle chassis and the various vehicle panels. This will facilitate ease of installation and consistency to ensure all antennas are fitted in precisely the same manner during motor vehicle building and installation of the antenna.

The antenna signal and co-axial cable can be connected to any point of the metal tube or at either end and not just at one end only as is the case with current forms of antennas.

Turning to Figure 1, an antenna rod 11 is capped by a top 12 and ends in a stop collar 13. Numeral 11A indicates a solid core which is overlaid by a filament - based element. A fixing anchor 14 fixes cylindrical housing 11 through base mould 15. Numeral 16 refers to a cylindrical housing, for example, of a suitable non-conductive plastics material, around antenna rod 11 which provides a guide. Numeral 17 refers to a coaxial cable to a radio.

Figure 2 relates to a manually-operated antenna and comprises an antenna rod 21, which is capped by a top 22 and ends in an antenna rod end stop 23. A locking nut 24 receives base mount 25 and connects flexible cylindrical housing 26 to vehicle panel 27.

In Figure 3, numeral 28 refers to a feeder cable.

Figure 4 relates to a power-driven antenna, in which numeral 29 refers to an electric motor for advancing or retracting antenna rod 21. Note that this motor is mounted away from the antenna mount, providing a space advantage.

In Figure 5, numeral 30 refers to a vehicle as a whole, numeral 27 referring to a panel of a part of the vehicle 30. Thus antenna rod 21 may be stored in a boot of vehicle 30. The antenna could be power-driven.

In Figure 6(a) and 6(b), numeral 31 refers to rollers driven by friction-device motor 29 to advance or retract antenna rod 21.

Turning to Figure 7, numeral 40 refers to a metal tube coated with a suitable non-conductive plastics material such as nylon or polyvinyl chloride and number 41 refers to an alternative connection point for a feeder cable.

Claims

1. A rod antenna which comprises a solid core selected from the group consisting of conductive and non-conductive cores overlaid by a filament-based element wrapped around the core at an angle to a line notionally drawn longitudinally along the core.

2. An antenna as claimed in claim 1, wherein braid is laid around the core at a suitable angle selected from 5 degrees to 75 degrees to a line notionally drawn longitudinally along the core.

3. An antenna as claimed in claim 2, wherein the angle is 40 degrees to 50 degrees.

4. An antenna as claimed in claim 1, wherein filament winding is used, the filaments being wound one over the other around the core but are not interlocked.

5. An antenna as claimed in claim 1, wherein tapes or sheets of filaments are wound around the core.

6. An antenna as claimed in claim 5, wherein the tapes or sheets of conductive filaments are woven.

7. An antenna as claimed in claim 1, wherein a prewoven sock of filaments is pulled over a core.

8. An antenna as claimed in claim 1, wherein a heat-shrink sleeving comprising a conductive plastics material may be placed around a non-conductive core and then shrunk to produce an electrically conductive rod.

9. An antenna as claimed in any one of claims 1 to 8, wherein the solid core is preferably a polymeric material which is associated with or impregnated with a strengthening material such as fibreglass or carbon fibres.

10. An antenna as claimed in any one of claims 1 to 9, wherein the solid core is preferably formed by pultrusion, which is a process in which continuous strands of fibrous reinforcing materials are pulled through a resin bath, a heated die, a pulling station and finally a cut-off unit.

11. An antenna as claimed in any one of claims 1 to 10, wherein the tensile strength of the rod at three standard deviations below the mean exceeds 1200 MPa when tested according to modified ASTM D - 3916.

12. An antenna as claimed in any one of claims 1 to 11, wherein the tensile modulus at three standard deviations below the mean exceeds 50 GPa when tested according to ASTM D - 3916.

13. An antenna as claimed in any one of claims 1 to 12, wherein the elongation at break is less than 3%.

14. An antenna as claimed in any one of claims 1 to 13, wherein mounting shear splintering does not progress further than 30mm on a standard mounting shear splintering apparatus.

15. An antenna as claimed in any one of claims 1 to 14 wherein the rod has inherent memory to return to its approximate straight position when fully extended, even after coiling or bending for extended periods in its retractable position.

16. A rod antenna which comprises a solid core selected from the group consisting of longitudinally arranged metallised non-metallic fibres and longitudinally arranged metal fibres.

17. A rod of selected stiffness and flexibility which may be extended or retracted and stored in a relatively small space, wherein the dimensions of the rod and the material or materials from which it is made are so selected that:

- the bending radius as measured by the survivable bend has a bend diameter (D) to antenna diameter (d) ratio of from 80 to 120 together with inherent built-in memory to allow the rod to return to the original straight position when released.

18. A tubular member useful for flexible storage of a rod antenna, which comprises a relatively flexible cylindrical housing provided with at least two anchoring means for attachment of the housing to a vehicle body.

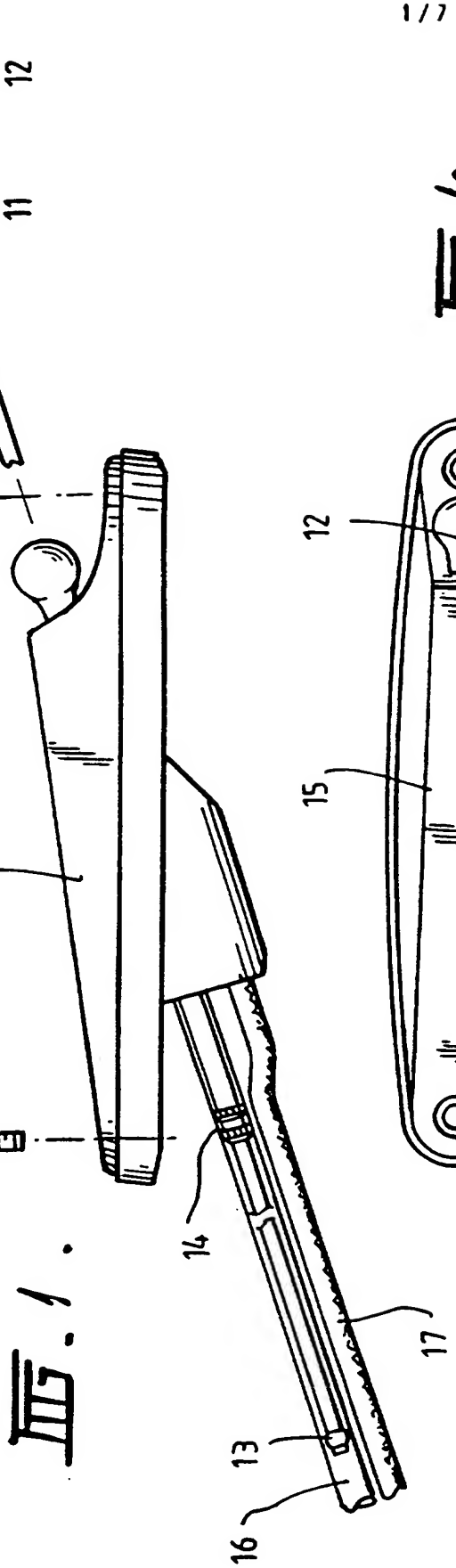


FIG. 1.

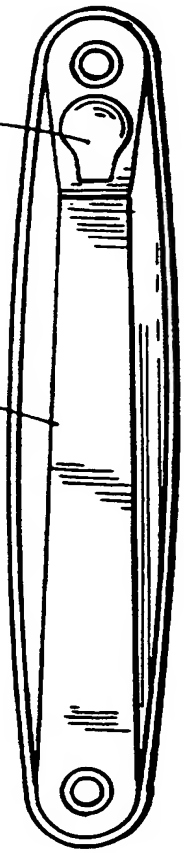


FIG. 1a.

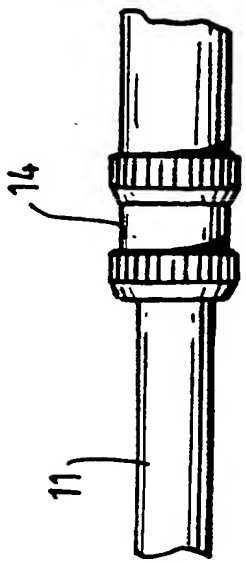


FIG. 1c.

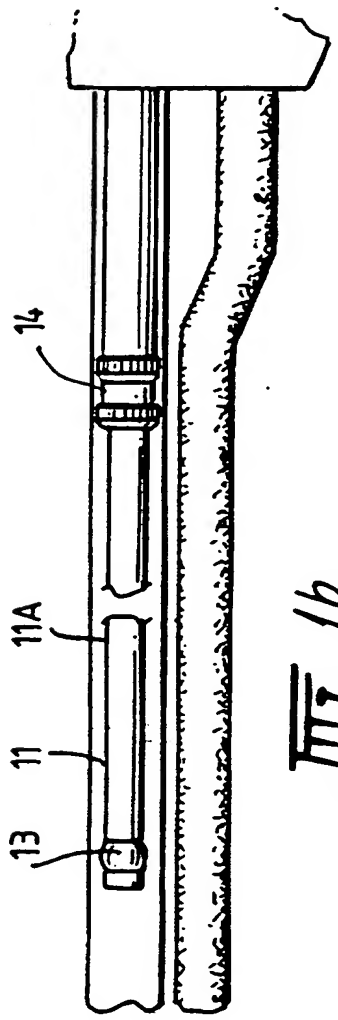


FIG. 1b.

FIG. 2.

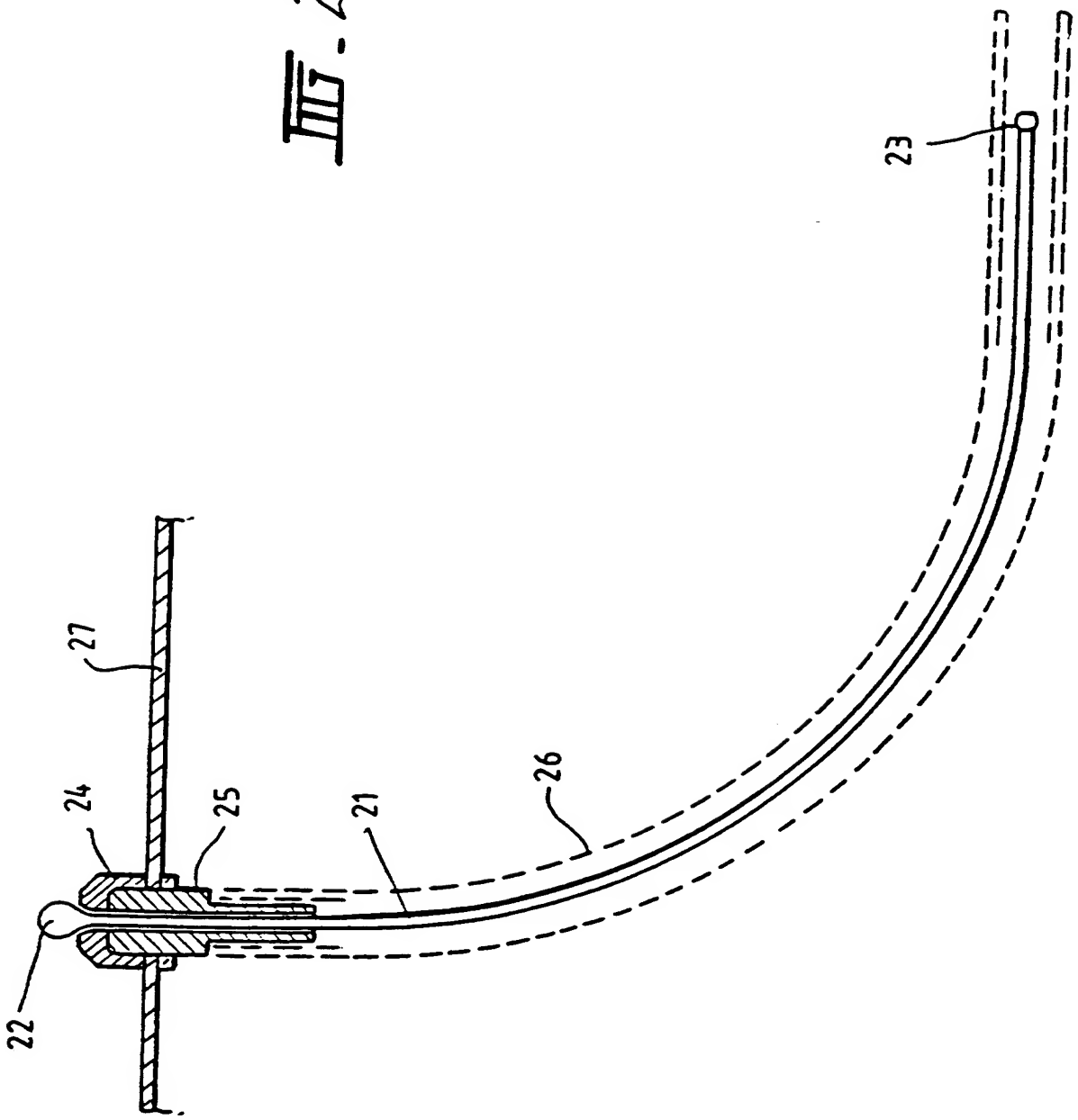


Fig. 3.

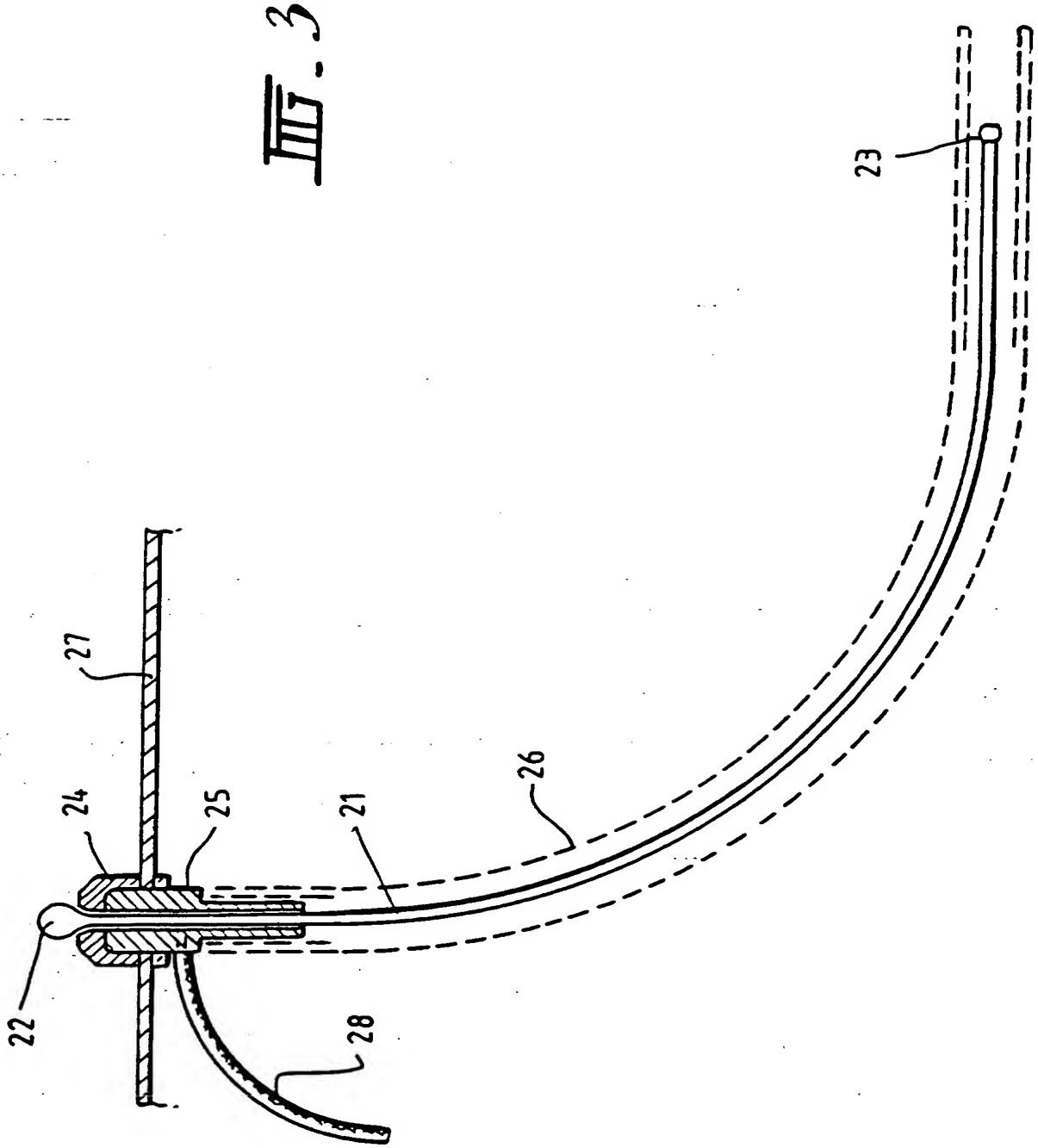
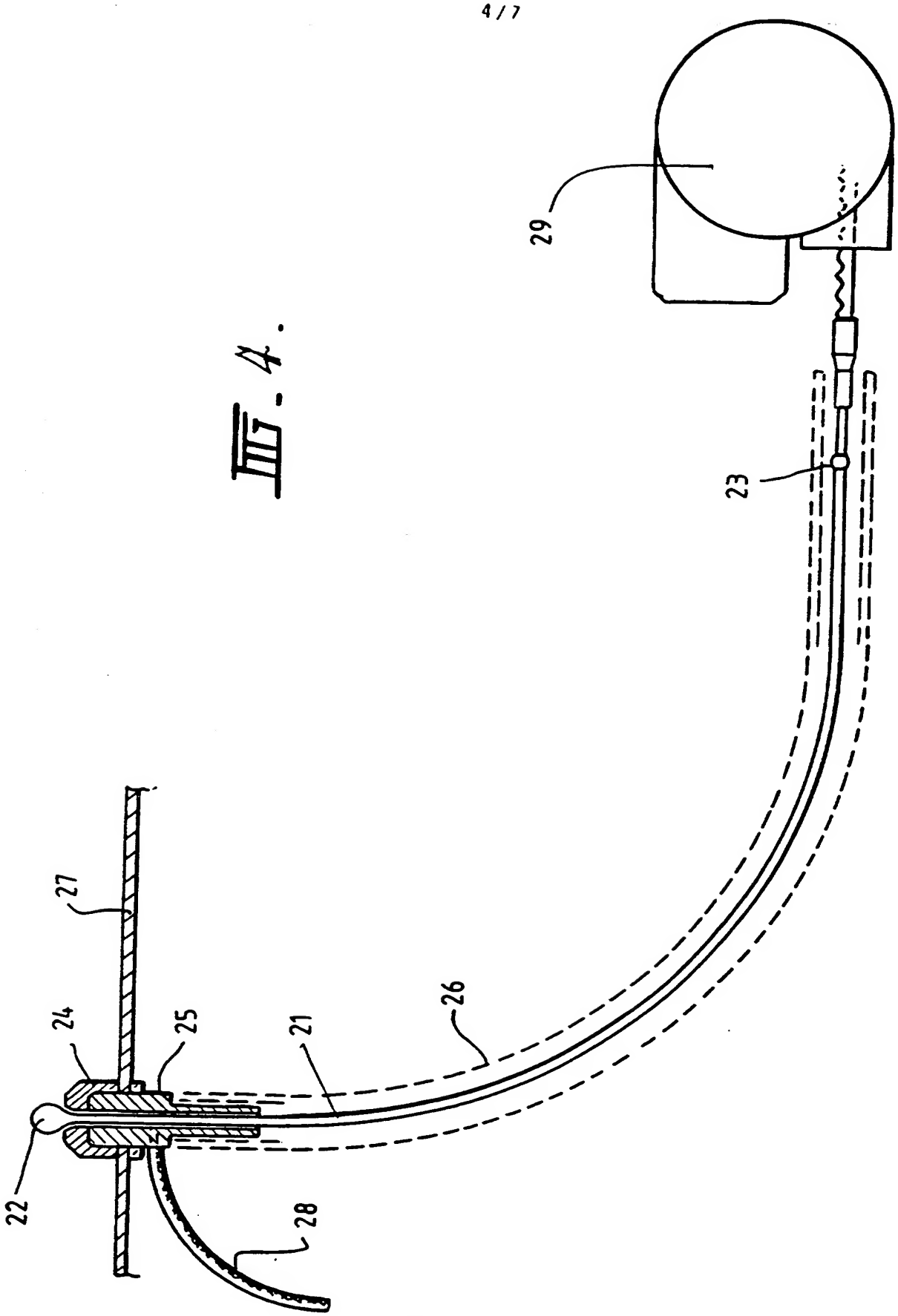


Fig. 4.



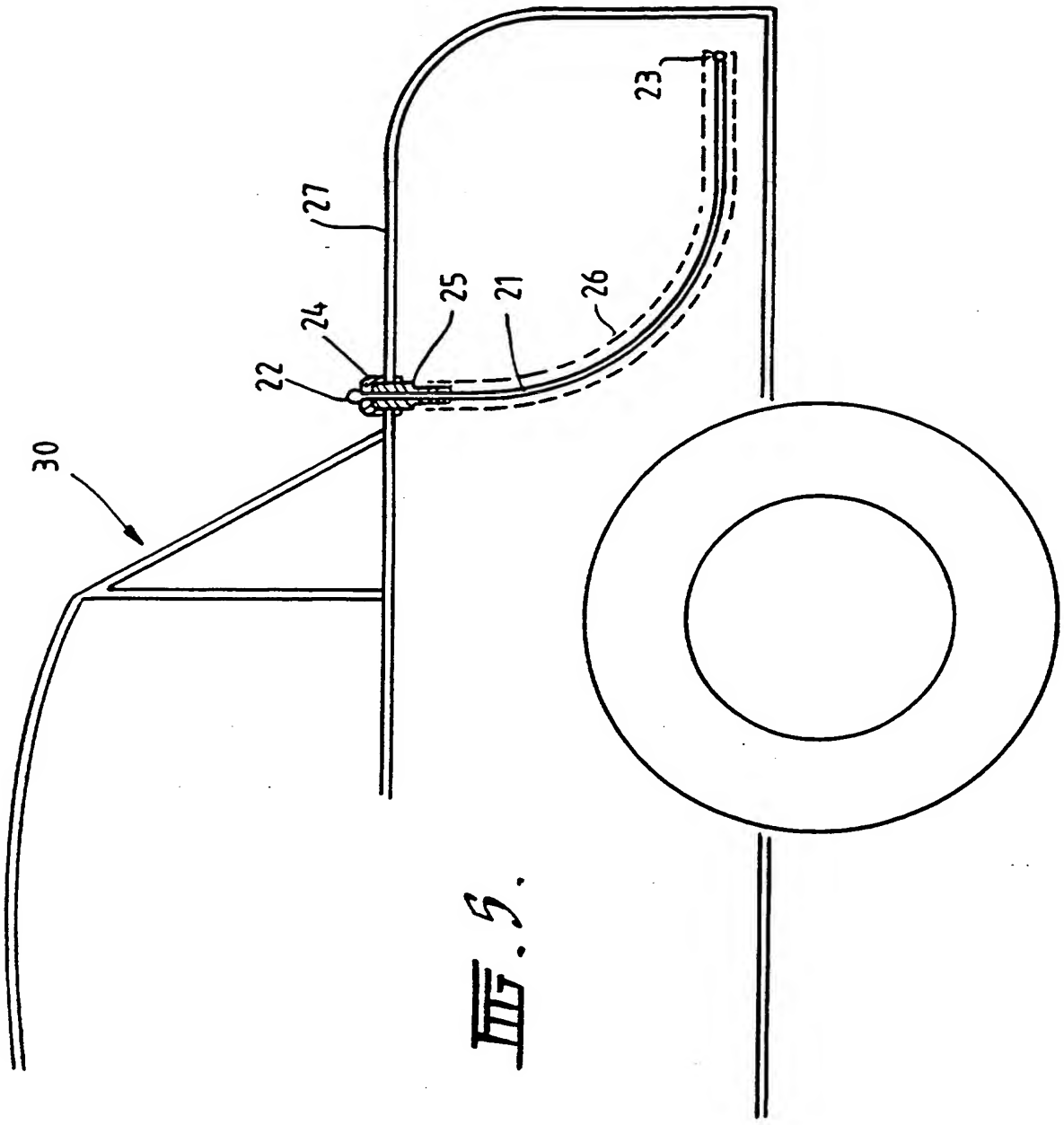


Fig. 5.

Fig. 6a.

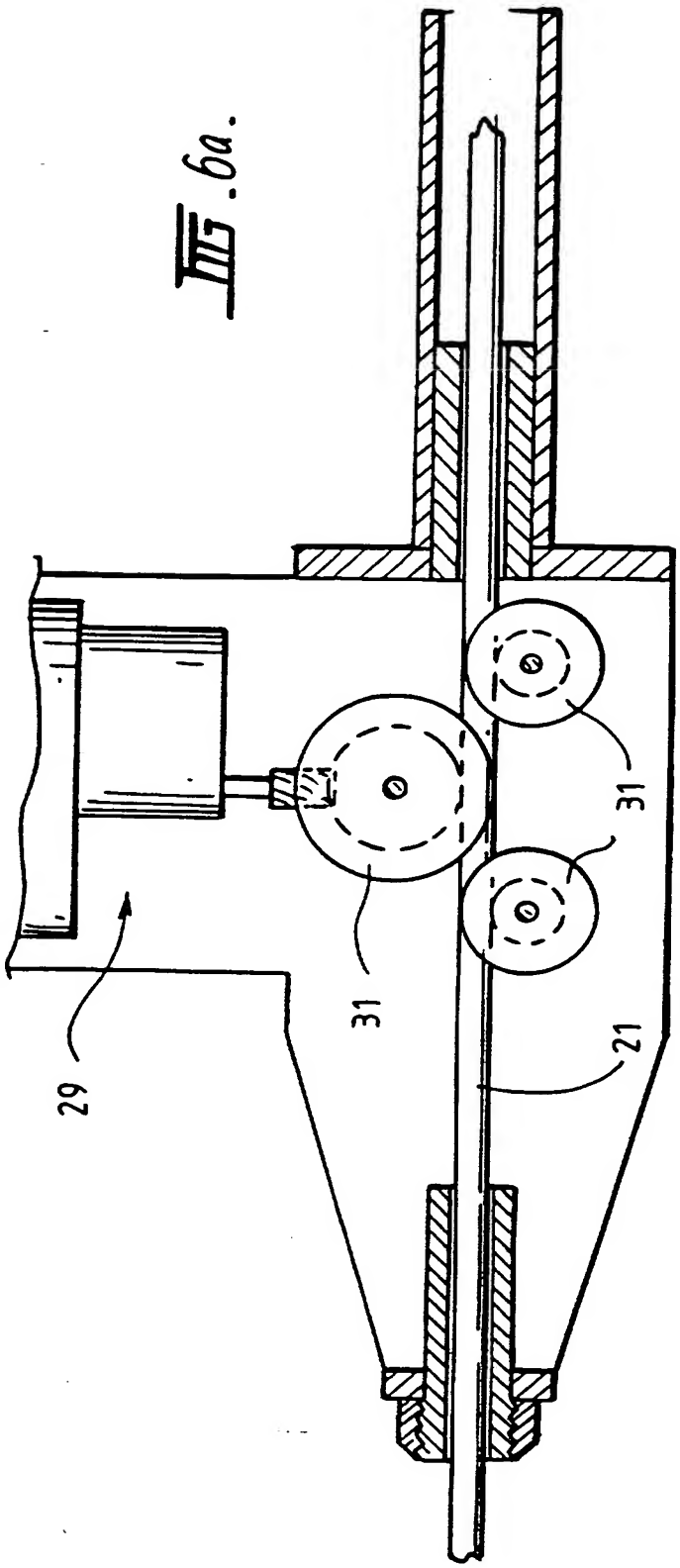


Fig. 6b.

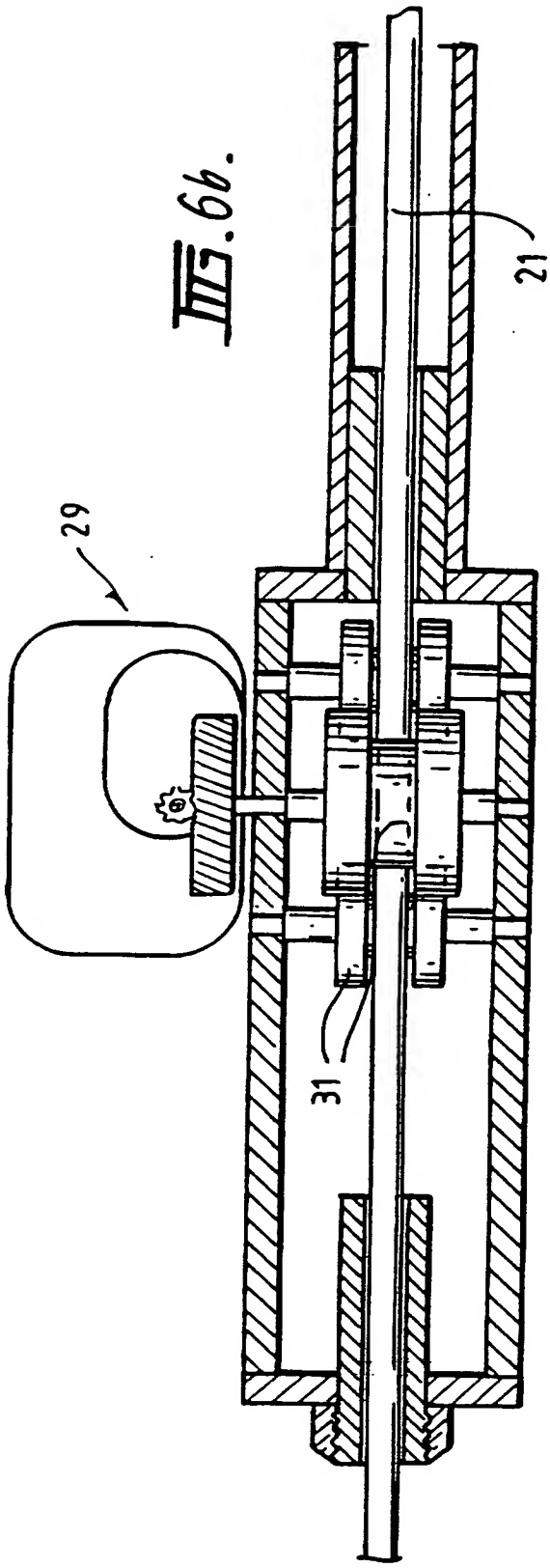
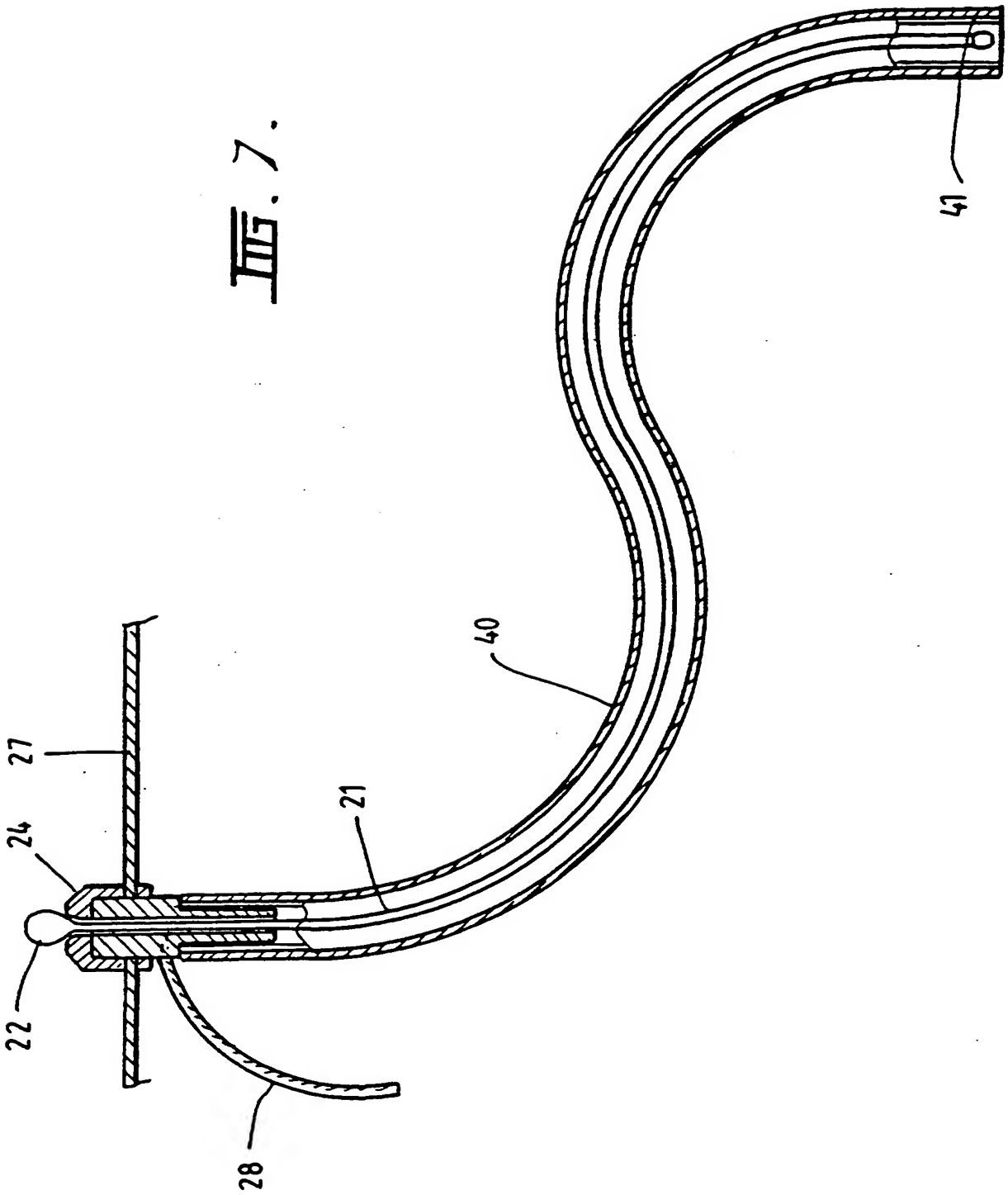


Fig. 7.



INTERNATIONAL SEARCH REPORT

International Application No. PCT/AU 96/00185

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl[6]: H01Q 1/08, 1/20, 1/32

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC : H01Q 1/08, 1/20, 1/32

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU : IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
DERWENT : Rod or Whip
JAPIO : Rod or Whip

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	GB 2156592 A (ASK MANUFACTURING LTD) 9 October 1995 page 1, lines 10-22; page 2, lines 1-10, lines 42-59 and lines 107-123 page 2, lines 107-109	1, 4-6, 15 10
X	US 3287732 A (EUCLID) 22 November 1966 column 1, lines 20-58; figure 2	1, 4-7

[X] Further documents are listed in the continuation of Box C

[X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
9 May 1996

Date of mailing of the international search report
21.05.96

Name and mailing address of the ISA/AU
AUSTRALIAN INDUSTRIAL PROPERTY ORGANISATION
PO BOX 200
WODEN ACT 2606
AUSTRALIA Facsimile No.: (06) 285 3929

Authorized officer
S. KAUL
Telephone No.: (06) 283 2182

Form PCT/ISA/210 (second sheet) (July 1992) cophin

INTERNATIONAL SEARCH REPORT

.rnational Application No.
PCT/AU 96/00185

C (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 801200 A (COLUMBIA PRODUCTS CO.) 10 September 1958 page 1, lines 56-74; figures 1-4	16
X	Derwent Abstract Accession No. B6688X/08, DE 2437098 A (MANNESMANNROHREN-W) 12 February 1976 Abstract	17
X	US 4447816 A (KURINA et al) 8 May 1984 whole document	17, 18
X Y	US 4494123 A (MOORE et al) 15 January 1985 whole document column 4, lines 1-10	17, 18 10
X	Derwent Abstract Accession No. L2477X/47, class R48, FR 2298199A (THOMSON-CSF) 17 september 1976 Abstract	18
A	Patent Abstracts of Japan, E-1209, page 97, JP 4-46407 A (HARADA IND CO LTD) 17 February 1992 Abstract	
A	GB 2221097 A (NIPPON ANTENNA CO LTD) 24 January 1990 whole document	
A	AU 48983/64 A (BELLING & LEE (AUST) PTY LTD) 9 March 1967 whole document	

INTERNATIONAL SEARCH REPORT

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
GB	2221097	DE	3919976	IT	1230911	JP	1321702
		US	4978966	FR	2635416		
AU	48983/72	BE	792199	CA	971047	DE	2255469
		GB	1389720	JP	48076565	NL	7215341
		US	3832970	FR	2162050		

END OF ANNEX